REMARKS/ARGUMENTS

Status Of Application

Claims 1-14 are pending in the application; the status of the claims is as follows:

Claims 1-14 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Funabashi , JP(A) 11-52451, in view of Hokari, U.S. Patent No. 5,654,565; and

Claims 1, 2, 8, and 9 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Koide, U.S. Patent No. 5,510,826 in view of Sugiyama , U.S. Patent No. 5,365,307, in further view of Hokari, U.S. Patent No. 5,654,565.

35 U.S.C. § 103(a) Rejections

The rejection of claims 1-14 under 35 U.S.C. § 103(a), as being unpatentable over Funabashi in view of Hokari, is respectfully traversed based on the following.

As the Examiner pointed out in the present office action, as a result of the foreign priority date for the present application, so long as a certified translation thereof is provided, Funabashi, JP(A) 11-52451, is not "prior art" under 35 U.S.C. § 102 or § 103, and thus is not available to be used as a basis for a rejection of a claim in the present application.

More specifically, the present application, U.S. Application Ser. No. 09/377,667, was filed on August 19, 1999, claiming priority of a prior foreign filing under 35 U.S.C. § 119(a)-(d) based on a Japanese application 10-243869, which was filed on August 28, 1998. The Examiner has acknowledged receipt of the Certified Copy of the priority document.

In contrast, Funabashi, JP(A) 11-52451, was published in Japan on February 26, 1999, about six months ***after*** the foreign priority date of the present application. Thus, in accordance with 37 C.F.R. 1.55, applicants may rely on the foreign priority date of the present application and overcome the date of Funabashi.

Thus, also in accordance with 37 C.F.R. 1.55, an English language translation of Japanese Application 10-243869 is provided herewith together with a verified statement that the translation of the certified copy is accurate.

Accordingly, it is respectfully requested that the rejection of claims 1-14 under 35 U.S.C. § 103(a) as being unpatentable over Funabashi in view of Hokari, be reconsidered and withdrawn.

The rejection of claims 1, 2, 8, and 9 under 35 U.S.C. § 103(a), as being unpatentable over Koide in view of Sugiyama and in further view of Hokari, is respectfully traversed based on the following.

The examiner's thoughtful comments on applicant's previous response and amendment are noted with appreciation.

With respect, however, it is submitted that Koide, Sugiyama and Hokari, singly or in combination fail to disclose, suggest or teach the invention of claim 1. Specifically, as noted previously, claim 1 requires:

> An image pickup device comprising:
> an image sensor having rectangular light receiving portions arranged in a matrix, and microlenses disposed in correspondence with said light receiving portions, said light receiving portions and said microlenses being formed integrally with each other; and
> an image input optical system for forming an image on said image sensor, said image input optical system including a diaphragm;
> wherein the diaphragm has a shape in a horizontal direction that coincides with a shape of said light receiving portions of said image sensor.

Thus, claim 1 requires that the opening in the diaphragm have a shape which corresponds to the shape of the light receiving portions of the image sensor. None of the references, whether taken singly or in combination suggest this limitation.

Koide is asserted as teaching a shape of a stop and the effect this has on the shape of the laser spot which is formed. Sugiyama and Hokari are cited for the proposition that the scanning surface 107 of Koide could be replaced by a sensor (Sugiyama) and that the sensor could have a integral microlenses (Hokari).

Koide discloses a laser scanning apparatus, such as would be used for a laser printer which has a stop 4 that is used to sharpen the point of laser light. As Koide explains, normally a laser beam has a Gaussian distribution cross-section (col. 1, line 48); *see also* Fig. 4. However, by passing the beam through stop 4, the beam can be sharpened (*i.e.*, the intensity of the beam near the edge of the beam can be made to drop off more abruptly) to have a Bessel distribution:

> Ideally when the light intensity distribution on the image carrier is a Bessel distribution, the beam spot diameter (i.e., a width at which the light intensity is decreased to $1/e^2$ with respect to a peak of 1) is minimized. That is, high-precision optical scanning can be performed.
> (col. 1, lines 63-67; *see also* Fig. 5).

Thus, the teaching of Koide is that a sharpness of the laser spot can be increased by passing the laser beam through the stop.

As acknowledged, Koide does not disclose any image sensor. Instead, Koide has a scanning surface 107 which is scanned by the laser beam. This surface is simply a curved plane. Thus, one fundamental distinction between the claimed invention and Koide is that the shape of the sharpened laser beam in Koide does not correspond to the shape of the surface 107 nor does it correspond to the shape of anything else. Instead the shape of the laser beam only corresponds to the shape of the laser spot which the laser beam forms when it strikes the surface.

Sugiyama discloses a microfilm system which suggests that a photosensitive drum thereof could be replaced with an image sensor. Sugiyama, however, is silent on any characteristics of the image sensor and provides no suggestion as to size or shape, etc. of the sensor or as to size or shape, etc. of the elements of the sensor. Similarly, Sugiyama is

silent as to any changes, adaptations, refinements or alterations to its optical system which might be needed or desired in the situation where the photosensitive drum is replaced with an image sensor. Thus it would take a leap of logic which is utterly unsupported by either Koide or Sugiyama that the shape of the laser beam spot should be adapted to match a shape of a sensor element.

Distilled to the essence, the present office action essentially suggests that if one went looking, a sensor might be found which corresponds to the shape of the laser spot and which, if substituted for the surface 107, would then create a system having a spot and sensor with similar shapes. The deficiency of this rejection is, therefore, that one would have to know what one was looking for—i.e., a sensor having a particular shape—in order to know that he had found it.

To invalidate a claim over a combination of references, the references themselves must suggest the desirability of the combination. With respect, in the present situation, the only possible source of motivation to choose selected references comes from impermissible hindsight gleaned from the disclosure of the present invention. MPEP 2142. That is, none of the references discloses, suggests or teaches that there should be a correspondence between a shape of the laser spot and the shape of anything else. Instead, as noted above, the only teaching of Koide is that the stop makes the laser spot sharp. Sugiyama only teaches that the drum can be replaced with a sensor (but says nothing whatsoever about the sensor). Hokari teaches microlenses with sensors. Accordingly, even if the teachings are combined, nowhere is there a suggestion that the shape of the stop or the beam should correspond to the shape of anything else. Thus, the references cannot suggest a system where the shape of a diaphragm and the shape of an image sensor are the same as claimed by claim1.

Because the cited references, whether taken singly or in combination, fail to disclose, suggest or teach the limitations of claim 1, these references are unable to render claim 1 obvious. Claim 2 depends from claim 1 and thus is nonobvious over the cited references for at least the same reasons as claim 1.

Claim 8 recites an input optical system for use with a particular type of sensor where the sensor has particular shape of light receiving portions. Claim 8 requires that a diaphragm of the optical system has a shape which coincides with the shape of the light receiving portions of the sensor.

As discussed above, the cited references, whether taken singly or in combination, fail to disclose, suggest or teach an optical system where the shape of a diaphragm and the shape of an image sensor intended to be used with the optical system are the same. For this reason, the references are unable to render claim 8 obvious. Claim 9 depends from claim 1 and thus is nonobvious over the cited references for at least the same reasons as claim 8.

Accordingly, it is respectfully requested that the rejection of claims 1, 2, 8, and 9 under 35 U.S.C. § 103(a) as being unpatentable over Koide in view of Sugiyama and in further view of Hokari, be reconsidered and withdrawn.

In view of the foregoing remarks, this application is considered to be in condition for allowance, and an early reconsideration and allowance are respectfully requested.

If an extension of time is required to enable this document to be timely filed and there is no separate Petition for Extension of Time filed herewith, this document is to be construed as also constituting a Petition for Extension of Time Under 37 C.F.R. § 1.136(a) for a period of time sufficient to enable this document to be timely filed.

Any other fee required for such Petition for Extension of Time and any other fee required by this document pursuant to 37 C.F.R. §§ 1.16 and 1.17, other than the issue fee,

and not submitted herewith should be charged to Sidley Austin Brown & Wood LLP's Deposit Account No. 18-1260. Any refund should be credited to the same account.

Respectfully submitted,

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December 29, 2003

DA1 274485v4

VERIFICATION OF TRANSLATION

I, Yumi Tsujimoto, 1-11-8, Morishouji, Asahi-Ku, Osaka City, Japan, hereby declare that I am conversant with the English and Japanese languages. I further declare that to the best of my knowledge and belief the following is a true and correct translation of Japanese Patent Application No.H10-243869.

Date: December 24, 2003

Yumi Tsujimoto

Yumi Tsujimoto

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Technology Center 2600

[Title of the Document]	Patent Application
[Reference Number]	P980828162
[Application Date]	August 28th, 1998
[Direction]	Commissioner, Patent Office
[Classification of International Patent]	G03B 9/02
[Title of the invention]	Image Sensing Unit
[Number of claims]	6
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[Description of Payment]	
[Method of Payment]	Prepayment
[Prepayment Registration Number]	024969
[Filing Fee]	21000
[List of Enclosures]	
[Document]	Specification 1
[Document]	Drawing 1
[Document]	Abstract 1
[Power of Attorney/Reference No.]	9716119
[Necessary or Unnecessary of Proof]	Necessary

[Title of the Document] Specification

[Title of the Invention] Image Sensing Unit

[Claims]

[Claim 1]An image sensing unit characterized by comprising:

an image sensing device including rectangular light receiving portions arranged in a matrix, and microlenses disposed in correspondence with said light receiving portions, said light receiving portions and said microlenses being formed integrally with each other;

an image input optical system for forming an image on said image sensing device; and

a diaphragm whose shape in a horizontal direction coincides with a shape of said light receiving portions of said image sensing device.

[Claim 2]An image sensing unit as claimed in claim 1, characterized in that said diaphragm has an oval shape that is circular in a vertical direction and is linear in the horizontal direction.

[Claim 3] An image sensing unit characterized by comprising:

an image sensing device including rectangular light receiving portions arranged in a matrix, and microlenses disposed in correspondence with said light receiving portions, said light receiving portions and said microlenses being formed integrally with each other;

an image input optical system for forming an image on said image sensing device; and

a light restricting plate whose shape in a horizontal direction coincides with a shape of said light receiving portions of said image sensing device, said light restricting plate being provided separately from a

diaphragm.

[Claim 4]An image sensing unit as claimed in claim 3, characterized in that said light restricting plate is disposed on one side in the horizontal direction.

[Claim 5] An image sensing unit as claimed in any of claim 3 and claim 4, characterized in that said light restricting plate has an oval shape that is circular in a vertical direction and is linear in the horizontal direction.

[Claim 6] An image sensing unit as claimed in claims 1 to 5, characterized in that said image sensing device has charge transferring portions adjoining said light receiving portions.

[Detailed Description of the Invention]

[0001]

[Technical Field] The present invention relates to an image input optical system for forming an image on light receiving portions of an image sensing device such as a CCD sensor or a CMOS sensor.

[0002]

[Prior Art] An image sensing device has light receiving portions arranged in a matrix, and vertically transferring portions for transferring charges generated by the light receiving portions in a vertical direction. A cross-sectional view of one pixel of the image sensing device is as shown in FIG. 11. A photodiode (light receiving) portion 5' constituting the light receiving portion and a vertical register portion 6' constituting the vertically transferring portion are disposed on a silicon layer 10 serving as a substrate. An insulative film 11 such as SiO2 is formed on the silicon layer 10. An electrode 8 for charge transfer is disposed on the register portion 6'. An aluminum light intercepting film 7 is disposed over the register portion 6'

and over a part of the photodiode portion 5'. Because of the presence of the light intercepting film 7, no light is directly incident on the register portion 6' from above. In order that no light is incident on the register portion 6' from a slanting direction, a predetermined distance d is set between the register portion 6' and the light receivable part of the photodiode portion 5'.

[0003]

[Problem to be Solved by the Invention] However, the light receiving portions of the image sensing device are longitudinally elongated in one column, whereas the luminous flux from an image input optical system for inputting light to the image sensing device is circular in cross section. For this reason, part of the input luminous flux is incident on areas outside the light receiving portions, and further, in the part of the luminous flux that is obliquely incident on the light receiving portions, the part incident on areas outside the light receiving portions corresponds to the light A in FIG. 11 being obliquely incident to reach the adjacent register portion 6', so that smears are generated. As a result, an output of high image quality cannot be obtained. Some of the luminous flux turns to reach the side of the register portion 6' to affect the register portion 6' after reflected at the light intercepting film like the light B.

[0004] The present invention is made in view of such points, and an object thereof is to provide an image input optical system capable of reducing the generation of smears in the image sensing device.

[0005] [Means for Solving the Problem] To attain the above-mentioned object, according to claim 1 of the present invention, the following are provided: an image sensing device including rectangular light receiving portions arranged

in a matrix, and microlenses disposed in correspondence with said light receiving portions, said light receiving portions and said microlenses being formed integrally with each other; an image input optical system for forming an image on said image sensing device; and a diaphragm whose shape in a horizontal direction coincides with a shape of said light receiving portions of said image sensing device.

[0006] According to this structure, since the shape of the diaphragm coincides with the shape, in the vertical direction, of the light receiving portions of the image sensing device, the quantity of the light directly incident on the register portion from a slanting direction or of the light incident on the register portion by being reflected at the light intercepting film is reduced on both sides of both side of the image sensing device, so that the generation of smears in the image sensing device is reduced.

[0007] Moreover, according to claim 2 of the present invention, in the above-described structure as claimed in claim 1, the diaphragm has an oval shape that is circular in a vertical direction and is linear in the horizontal direction.

[0008] According to this structure, since the diaphragm has an oval shape, is circular in the horizontal direction in accordance with the effective aperture of the diaphragm and is linear in the vertical direction so as to coincide with the vertical direction shape of the light receiving portion, an effect of reducing smears is obtained.

[0009] Moreover, according to claim 3 of the present invention, the following are provided: an image sensing device including rectangular light receiving portions arranged in a matrix, and microlenses disposed in correspondence

with said light receiving portions, said light receiving portions and said microlenses being formed integrally with each other; an image input optical system for forming an image on said image sensing device; and a light restricting plate whose shape in a horizontal direction coincides with a shape of said light receiving portions of said image sensing device, said light restricting plate being provided separately from a diaphragm.

[0010] According to this structure, since the light restricting plate restricting light only in the horizontal direction is provided separately from the diaphragm, the luminous flux is restricted by the light restricting plate to reduce the quantity of the light that reaches the register portion, so that an effect of reducing smears is obtained.

[0011] Moreover, according to claim 4, in the structure as claimed in claim 3, said light restricting plate is disposed on one side in the horizontal direction.

[0012] According to this structure, when the smear level of the image sensing device is different between on the left side and the right side, an effect of reducing the smear level is obtained only by restricting the luminous flux by the light restricting plate only on one of the left and the right sides.

[0013] Moreover, according to claim 5, in the structure as claimed in claim 3 or 4, said light restricting plate has an oval shape that is circular in a vertical direction and is linear in the horizontal direction.

[0014] Moreover, according to claim 6 of the present invention, in the structure as claimed in claims 1 to 5, said image sensing device has charge transferring portions adjoining said light receiving portions.

[0015] According to this structure, a signal can be extracted by transferring signal charges of each light receiving portion by the charge transferring

portions adjoining the light receiving portion array.

[0016] [Embodiments of the Invention] <First Embodiment> Hereinafter, preferred embodiments of the present invention will be described. FIG. 1 is a view showing the structure of an image sensing unit according to a first embodiment of the present invention. A light restricting plate 1 and a diaphragm 2 are inserted in an image input optical system comprising a plurality of lens elements. An image sensing device 3 comprising a CCD is disposed at the image plane of the image input optical system.

[0017] FIG. 2 is a view showing the pixel structure of the image sensing device 3. The image sensing device 3 comprises light receiving portions 5 arranged in a matrix, and vertically transferring portions 6. The light receiving portions 5 each comprise, for example, a photodiode, and generate charges that are proportional to the intensity of the received light. The vertically transferring portions 6 are formed so as to adjoin the light receiving portion columns. The structure of the image sensing device 3 is detailed in FIG. 11.

[0018] When the pixel density of the image sensing device 3 is increased, the size of the light receiving portions 5 is decreased, so that a great output cannot be obtained. For this reason, in recent image sensing devices 3, a microlens 8 is disposed in correspondence with each light receiving portion as shown in FIG. 3 in order to obtain a high vignetting factor. Reference number 7 represents a light intercepting aluminum film formed over the area other than the light receiving portions 5. Since light can be condensed in an area larger than the light receiving portion 5 by the microlens 8 as shown in the figure, the signal charge amount at the light receiving portion 5

increases. In the image sensing device having the microlenses, strictly, an image is formed at the vertices of the microlenses. At this time, in the image, the diaphragm of the input optical system and the light receiving portions of the image sensing device are in a conjugate relationship because of a working of the microlenses. When such a relationship is satisfied, the shape of the diaphragm (or the shape of the restricting plate) is very important as described later.

[0019] FIG. 4 shows, with respect to the light receiving portion 5, the difference in width of the incident luminous flux due to the difference in lens aperture, that is, in F number. Here, the smaller circle 18 represents the luminous flux in the case where the image input optical system has a small aperture, and the larger circle 17 represents the luminous flux in the case where the optical system has a large aperture. Since the light receiving portion 5 is elongated not in the horizontal direction but in the vertical direction, part of the luminous flux is incident on the areas horizontally adjoining the light receiving portion 5 as shown by the circle 17 in the case of the large-aperture optical system, so that only a luminous flux of f/3.0 to f/4.0 is incident on the light receiving portion 5. When part of the luminous flux is incident on areas outside the light receiving portion 5 as shown by the circle 18, the part affects the vertically transferring portions (registers) 6, so that smears are generated.

[0020] Therefore, the luminous flux can appropriately be restricted with respect to the light receiving portion 5 when the diaphragm has, for example, a small oval shape as shown in FIG. 5. That is, as long as having this shape, the diaphragm can appropriately restrict light in the horizontal direction at

the left and the right ends of the light receiving portion 5. Consequently, no light is incident on the vertical register portion 6 (see FIG. 11), so that the generation of smears is reduced. Further, with respect to the vertical direction, since light is incident on a large area of the light receiving portion 5, light is efficiently received. While the oval shape of FIG. 5 is linear in the vertical direction in correspondence with the shape of the light receiving portion, it is circular in the horizontal direction. The circular shape in the horizontal direction is decided in accordance with the effective aperture of the image input optical system. The shape in the vertical direction is decided based on the angle of view of the image sensing device.

[0021] Since the diaphragm 2 has an oval shape, the luminous flux in the horizontal direction is cut with respect to the image sensing device 3 to thereby restrain the generation of smears, and the quantity of light incident in the vertical direction is increased so that signal charges are generated with efficiency.

[0022] Consequently, a high-quality image with few smears is obtained without the output of the image sensing device 3 being largely reduced. The diaphragm 2 does not necessarily have the oval shape but may have a shape, for example, that is linear in the vertical direction and is also linear in the horizontal direction. Moreover, the linear shape in the vertical direction may be provided only on one side. FIG. 9 is a view showing a phenomenon in which smears are generated due to a displacement between the entrance pupil and the exit pupil of the input optical system. Normally, the entrance pupil of the image sensing device 3 is set at infinity. That is, the image sensing device 3 is set on the assumption that a parallel light ray is incident

thereon through the image input optical system. The exit pupil of the image input optical system is frequently situated at a finite distance with respect to the image sensing device 3. For this reason, there is a displacement between the entrance pupil and the exit pupil, so that the luminous flux is obliquely incident on the light receiving portions 5 of the image sensing device 3 as shown in FIG. 9. Consequently, the relative position relationship of the luminous flux with respect to the light receiving surface is different between on the right and the left sides of the image sensing device. For this reason, light enters the vertical transferring portion 6 as shown in FIG. 11, so that smears are largely generated. A light restricting plate 4 may be used for restricting the generation of the smears.

[0023] For example, in FIG. 1, the light restricting plate 1 for restricting the luminous flux in the horizontal direction is inserted separately from the diaphragm 2. In this embodiment, the light restricting plate 1 is inserted directly behind a lens 4 disposed ahead of the diaphragm 2. The light restricting plate 1 has a shape being cut along two parallel straight lines in the vertical direction as shown in FIG. 6. Consequently, the luminous flux incident on the light receiving portion 5 which luminous flux has been restricted by the diaphragm 2 into a circular shape is further restricted by the light restricting plate 1 as shown in FIG. 12, so that the luminous flux has a shape being cut along two parallel straight lines in the vertical direction so as to coincide with the vertical direction shape of the light receiving portion 5.

[0024] In FIG. 12, reference number 30 represents the luminous flux incident on a light receiving portion 5R on the right side of the image sensing

device 3, whereas reference numeral 31 represents the luminous flux incident on a light receiving portion 5L on the left side of the image sensing device 3. With this arrangement, the quantity of the light directly incident on the vertical register portion 6 from a slanting direction or of the light incident on the portion 6 by being reflected at the light intercepting film 7 is reduced on the right and the left sides of the image sensing device 3, so that the generation of smears in the image sensing device 3 is reduced.

[0025] The level of the smears generated in the image sensing device 3 sometimes differs between on the right and the left sides. For this reason, the smear level is also reduced by inserting the light restricting plate for intercepting light on the side where the smear level is higher as shown in FIG. 7. In this case, since the fabrication is easier than in the case where the light restricting plate shown in FIG. 6 is inserted, the manufacturing cost is reduced.

[0026] <Second Embodiment> Subsequently, a second embodiment of the present invention will be described. FIG. 8 is a view showing the structure of an image sensing unit according to the second embodiment. The optical system of this embodiment is a two-component zoom lens optical system of a negative and a positive lens element configuration. A restricting plate 22 is disposed in a first lens unit 20, and a diaphragm 23 is disposed in a second lens unit 21. The restricting plate 22, which is not limited thereto, is disposed only on one side as shown in FIG. 7. First, light having passed through the first lens unit 20 has its luminous flux restricted by the light restricting plate (light restricting plate) 22 and has its quantity adjusted by the diaphragm 23. Then, the light passes through the second lens unit 21 to

reach the image sensing device 24. The image sensing device 24 has a structure as shown in FIGs. 2 and 3. The condition in FIG. 8 is the wide-angle condition (W). The first lens unit 20 first approaches the second lens unit 21 and then, moves away therefrom to make a U-turn as shown by the arrow 25 and the second lens unit 21 approaches the first lens unit 20 as shown by the arrow 26, whereby the optical system is brought to the telephoto condition (T).

[0027] Here, when the aperture of the diaphragm 23 is invariable, the aperture of the image input optical system is larger in the wide-angle condition than in the telephoto condition, and the generation of smears is greater in the wide-angle condition. It is most effective in preventing the generation of smears that the F number in the horizontal direction is invariable during zooming. This can be achieved by increasing the aperture of the diaphragm 23 in the horizontal direction in accordance with the driving of the second lens unit 21 to the telephoto condition.

[0028] In this case, however, a driving mechanism for varying the aperture of the diaphragm 23 is required, so that the structure is complicated. Therefore, in this embodiment, in the wide-angle condition, the light restricting plate 22 is used to reduce the generation of smears. In the telephoto condition, the luminous flux adjustment is made by the diaphragm 23. Consequently, the generation of smears in the wide-angle condition is reduced with a simple structure. As a result, smears in the wide-angle condition are improved with a simple structure.

[0028] In this case, however, a driving mechanism for varying the aperture of the diaphragm 24 is required, so that the structure is complicated.

Therefore, in this embodiment, in the wide-angle condition, the light restricting plate 22 is used to reduce the generation of smears. In the telephoto condition, the luminous flux adjustment is made by the diaphragm 23. Consequently, the generation of smears in the wide-angle condition is reduced with a simple structure. As a result, smears in the wide-angle condition are improved with a simple structure.

[0029] According to the zooming image sensing unit of this embodiment, the luminous flux in the horizontal direction can be restricted by the restricting plate 22 provided separately from the diaphragm 23, so that the generation of smears can be reduced with a simple structure. Moreover, in this embodiment, the restricting plate 22, which restricts light only in one direction of the image sensing device 24, can easily be fabricated.

[0030]

[Effects of the Invention] As described above, according to the present invention, in the image input optical system, the luminous flux is restricted by the diaphragm or the restricting plate formed based on the shape of the image sensing device, so that smears are significantly improved without the output level at the image sensing device being largely reduced.

[0031] Moreover, in the image input optical system as claimed in claim 2 and claim 6, since the luminous flux is restricted in an oval shape, it is linearly restricted in the vertical direction to reduce the generation of smears and in the horizontal direction, the large reduction in light quantity is prevented in accordance with the effective aperture.

[0032] Moreover, in the image input optical system as claimed in claim 10, since the luminous flux restriction in the wide-angle condition by the zoon

lens system is performed by the light restricting plate disposed in the first lens unit, the generation of smears in the wide-angle condition can be appropriately reduced although the structure is simple.

[Brief Description of the Drawings]

[FIG. 1] A view showing the structure of the image sensing unit according to the first embodiment of the present invention.

[FIG. 2] A view showing a part of the CCD sensor of the image sensing unit.

[FIG. 3] A view showing the structure of one light receiving portion of the CCD sensor.

[FIG. 4] A cross-sectional view of a part of the CCD sensor.

[FIG. 5] A view showing the shape of the diaphragm provided in the image input optical system.

[FIG. 6] A view showing another shape of the diaphragm.

[FIG. 7] A view showing still another shape of the diaphragm.

[FIG. 8] A view showing the structure of the image sensing unit according to the second embodiment of the present invention.

[FIG. 9] A view showing the relationship between the pupil of the image input optical system and the image sensing device.

[FIG. 10] A view showing the positions of the luminous flux being incident on the light receiving portions of the image sensing device.

[FIG. 11] A cross-sectional view of a part of the light receiving portion of the image sensing device, for explaining the cause of smears generated in the image sensing unit.

[FIG. 12] A view showing the luminous fluxes incident on the light receiving

portions on both sides of the image sensing device of the image sensing unit according to the first and the third embodiments of the present invention.

[Explanation of the Reference Numerals]

1 light restricting plate

2 diaphragm

3 CCD sensor

5 light receiving portion (photodiode portion)

6 vertically transferring portions (vertical register portions)

7 aluminum film

8 microlens

10 silicon (Si) layer

11 oxide film

12 pupil

13 optical axis

20 first lens unit

21 second lens unit

22 light restricting plate

23 diaphragm

24 CCD sensor

[Title of the Document] Abstract

[Abstract]

[Problem] To provide an image sensing unit not largely reducing the output of the image sensing device and being capable of significantly improving the smear level.

[Solution] An image input optical system forming an image on the light receiving portions of an image sensing device 3. The image input optical system has a diaphragm whose shape in the vertical direction coincides with the shape of the light receiving portions in the vertical direction.

[Selected Drawing] Figure 1